Winfield

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June 23, 2017

Dominic L.DiSalvo, P.E., BCEE, Director
Bergen County Utilities Authority
P.O. Box 9 Foot of Mehrhof Road
Little Ferry, New Jersey 07643

Dear Mr. DiSalvo,

Re: Comments on the Draft Lower Hackensack River Nutrient TMDL Study (Volume 1 - Model Development and Calibration) - Submitted November 10, 2016

The New Jersey Department of Environmental Protection's (Department) Division of Water Monitoring and Standard's Bureau of Environmental Analysis, Restoration and Standards (Bureau) is responsible for the development of Total Maximum Daily Loads (TMDLs) for 303(d) list of impaired waters. In this capacity, we strive to provide a transparent process that informs and provides the foundational basis for the selection of the TMDL model, as well as model calibration and validation, and model inputs and assumptions. These materials comprise the administrative record that support the establishment of the TMDL as well as the calculations/allocations used in the TMDL development. The Lower Hackensack Nutrient TMDL Study was initiated under the auspices of a Model Evaluation Group (MEG) which supported the development of a Lower Hackensack River model. During the ensuing years, the Bergen County Utilities Authority (BCUA) with its consultants prepared the Lower Hackensack River Data Report and Modeling Report, the latter which was submitted to the Department on November 10, 2016.

The Department has prepared over 500 TMDLs including two comprehensive nutrient TMDL Reports for the Passaic River and Raritan River basins resulting in the delisting of over 70 waterbody/pollutant combination from the 303(d) list. The Passaic and Raritan TMDLs were Department led studies and through a contract with the Rutgers NJ EcoComplex, were subject to a panel of experts that weighed in on each major step of the TMDL process.

Multiple reports and presentations were put forth that comprised the administrative record. Whereas the Lower Hackensack TMDL was an outcome of a partial stipulation of settlement agreement between BCUA and the Department's Division of Water Quality (DWQ) and did not include a process for the review of TMDL development milestones. As discussed in the May 1, 2017 meeting, EPA and the Department agreed that an independent review through a MEG be conducted for determination of adequacy of the calibration and subsequently determination of usability of the calibrated model for TMDL development and other management decisions. To ensure continuity in model review, we will strive for two previous MEG members and two new experts to comprise the new MEG, the discussion of which will occur under separate cover.

Our comments include the request for additional information to document to the Department's (and EPA's) satisfaction, supporting materials that will be used to confirm appropriateness of the model calibration and perform the TMDL analyses, including any assumptions and their basis; a discussion of strengths and weaknesses in the analytical processes; and results from the water quality modeling. Thus, if this model is used to develop a TMDL, it must be sufficient to address critical conditions, seasonal variation and to adequately and appropriately simulate water quality parameters consistent with the duration and frequency of New Jersey's water quality standards.

In the letter dated August 27, 2007, the Department required BCUA to make the model publicly available to which, BCUA agreed (e.g. page 7 of the partial stipulation of settlement). In order to conduct a complete comprehensive technical review of the model, we request that input/output/data display files for all runs used to generate the report, model executable and all differential equations which are used to generate the results for the report. Please supply a file including the calibration parameter constants and coefficients used by the model. Once these materials are received and reviewed, we may have additional comments. If BCUA is unable to provide the computer code for the models used in the analysis, we request an executable file for the model calibration with monitoring data and model display capability. The request for the model is to allow for a thorough evaluation of the model and results as the adopted TMDL's wasteload allocation will serve as the basis for the Department's New Jersey Pollution Discharge Elimination Permit dissolved oxygen permit limit.

As the Bureau ultimately responsible for both the adoption of the TMDL as an amendment to the appropriate Water Quality Management Plan and submittal of the TMDL to EPA for their approval, this letter with its attachment serves as our official comments on the draft Model Development and Calibration Report submitted to you for response. The Department truly recognizes and appreciates the tremendous amount of work that went into the planning, monitoring, model development and calibration in an effort towards the shared goal of addressing nutrient-related water quality issues in the Lower Hackensack River. The BCUA presentation and discussion on May 1, 2017 was helpful in clarifying some of our initial review comments; however the Department must ensure that the TMDL model simulates and predicts the Lower Hackensack River's assimilative capacity. Your response document and/or an addendum to the Model Development and Calibration report will provide the documentation necessary to move forward towards proposing a TMDL.

Very truly yours,

Kimberly Cenno

Kimberly Cenno, Bureau Chief

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Helen Pang, NJDEP - BEARS
Biswarup Guha, NJDEP - BEARS
Michele Putnam, Director NJDEP – DWQ
Janice Brogel, Asst. Director NJDEP – DWQ
Rosella O'Brien, EPA
Richard Winfield, EPA
Antony Tseng, EPA

Enclosure: Draft Lower Hackensack River Nutrient TMDL Study (Volume 1 - Model Development and Calibration Comment Document

Draft Lower Hackensack River Nutrient TMDL Study (Volume 1 - Model Development and Calibration Comment Document

We offer the following comments for your response:

Phosphorus

1) Whether phosphorus is important or not for the portion of the river above station W5 should be discussed further. The Department recognizes that in the early phase of this project, the initial MEG reached a consensus that phosphorus was less important in the lower portions of the Hackensack River; however, additional discussion is necessary based on the findings from the data and modeling. The residence time analysis at stations above W5 will also be useful to evaluate the significance of this issue.

Model Calibration and Evaluation

1) Please include component analyses of the pollutant loads, nitrogen, phosphorus and carbon and sensitivity analyses of the loads and modeling coefficients to evaluate the impacts of Newark Bay boundary conditions, sediment oxygen demand (SOD), wastewater treatment plants, Combined Sewer Overflows (CSOs), and marsh loads on the dissolved oxygen and to understand what is driving dissolved oxygen responses. Also, include a summary of the loadings for model calibration in the report. A sensitivity analysis on SOD is important to further confirm SOD values measured using the in-lab procedure.
2) The SWEM model runs indicated that the Lower Hackensack River dissolved oxygen response was driven by carbon and nitrogen loadings. Has the impact of carbon (as compared to nitrogen and phosphorus) been evaluated in the LHR model? If so, please discuss. If not considered, please elaborate why it was not considered.
3) Per a Department review of submitted WWTP DMR information, the Department arrived at three different possible 2010 summer input values (i.e. SMUA summer discharge flow (~3mgd), summer CBOD (~10mg/l), and summer NBMUA DO ~6mg/l). At our May 1st meeting, BCUA acknowledged that the draft report will be corrected per their review of this information.

4) Additional documentation is needed to support the conclusion that light might be the limiting factor for algal growth. A comparison of model computed light extinction versus secchi depth would be useful.
5) Further explanation is needed to support the conclusion of "a lack of diurnal signal" suggesting that the upper reaches of Lower Hackensack are not dominated by algal dynamics (p. 9-10 of report).
6) The Department requires further explanation of the decision not to use NJHDG water quality sample results (middle paragraph on page 7). There is NJHDG station monitoring data within the LHR model domain during the calibration timeframe. The NJHDG data could supplement model validation and potentially allow extending the model simulation time frame. If acceptable, both BCUA intensive sampling events (August and October 2010) could be utilized in model calibration. At the May 1st meeting BCUA indicated that figures could include this data for visual comparison.
7) Spatial profiles for dissolved oxygen, chlorophyll-a, nitrogen, cBOD5 and other key water quality parameters would be useful and should be provided.
8) The model performance is evaluated on the comparison of mean data. The calibration and validation evaluation via measures-of-fit should be included. "Box-whisker" plots/additional comparison information will be valuable. (e.g. Table 4.2, 4.3, 4.5, 4.10, 4.11, 4.12, etc). Figures presented at the May 1st meeting were helpful and should be supplied.
9) The report states that the model performance is good when considering long-term simulation results. The report cautions against the model's use for shorter timeframe evaluations. Please provide a measures-of-fit for various timeframes (e.g. weekly, monthly) to better clarify review of model utility.
10) Please explain further the statement, "Note that the workplan specified a precision (reproducibility) of ±25%" and "average difference between chlorophyll-a duplicate pairs is about 50%" (page 20 & 23). Please provide a reference for these thresholds and describe how these were calculated. The precision (reproducibility of ±25%) is not consistent with the workplan which states ±10-20%.

Additional Comments

1) The report would benefit from having an executive summary.
2) Please cite the pertinent figures submitted, or include figures/information that would support seasonal stratification in the study area (as summarized in the first bullet on page 10 of the TMDL study).
3) All "final" data generated under the project should be submitted to the Department electronically in spreadsheet form. Previously, the "preliminary" continuous data was submitted. Also, please confirm that the data can be made publicly available. At the May 1st meeting, BCUA indicated this was the final data report.
4) Please indicate the residence time in the model-domain and whether the residence time changes in various reaches (mid-paragraph page 9). Please supply this for each station in the same fashion as W1 results in the presentation slide from the May 1st meeting.
5) Provide additional basis for the statement, "significant upgrades to BCUA's facility should be delayed until such time as other sources have been removed or otherwise remediated" found on page 6 of the TMDL study.
6) Please provide the citations for the data sources specified at the beginning of page 17.
7) Please provide more information for the W4 note on stratification (page 43).
8) Please provide additional support on the statement that "Several DO "crashes" were observed… rather than a discharge-related event" (as found on page 18) in the TMDL study.

The selected comments below were based on input from EPA. Some of the comments have been discussed with BCUA at the May 1st meeting and the Department concurs that they should be addressed and included in the final Model Development and Calibration Report.

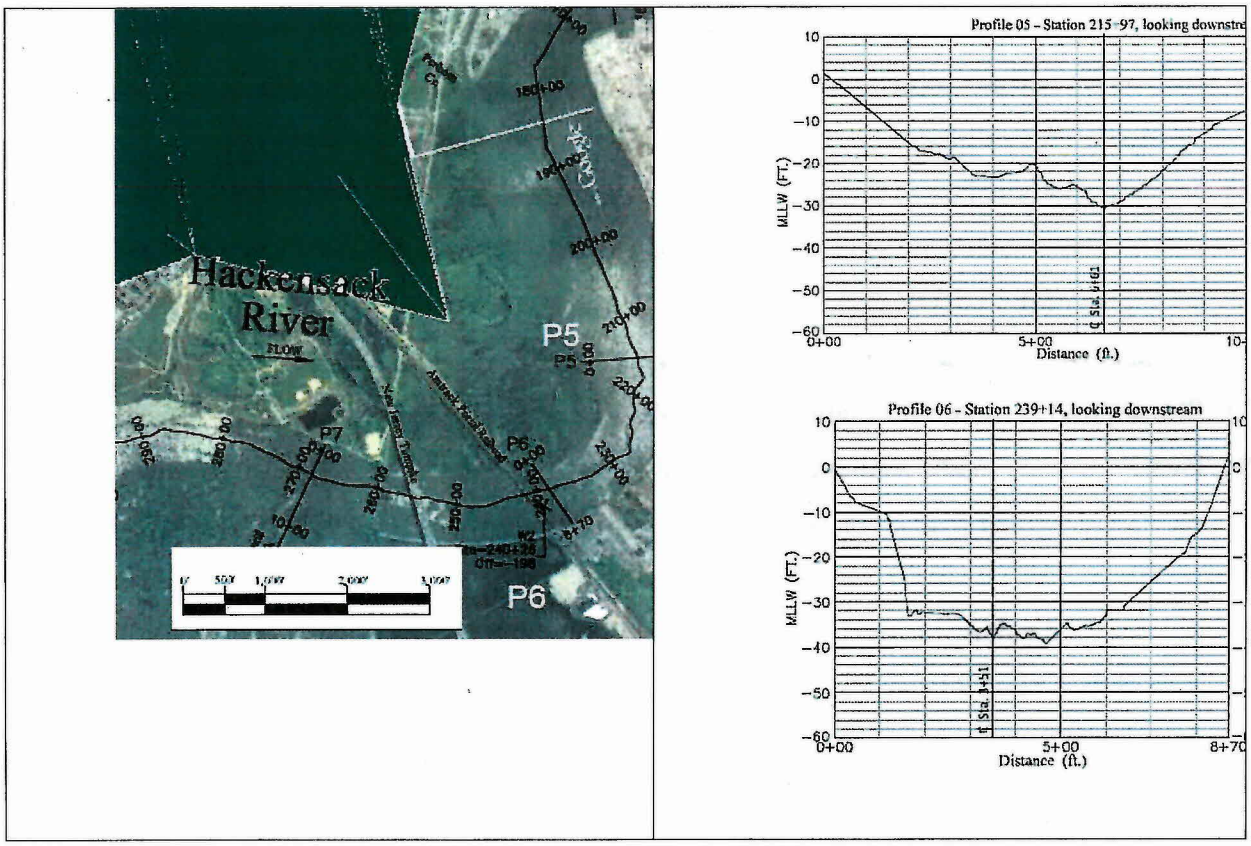
River Geometry

To assist with being able to replicate the engineering calculations - such things as the cross-section areas, top widths, average depths, etc. calculated from the Alden profiles *(see App D - Bathymetric Profiles)* are requested, along with the actual geometry used in both the 1988 and 2010 models – or was the same geometry used? Please confirm that the information shown in Figure 2.2 as "2010 Walden" corresponds to the Appendix D "Alden"?

River Cross-Sectional Area

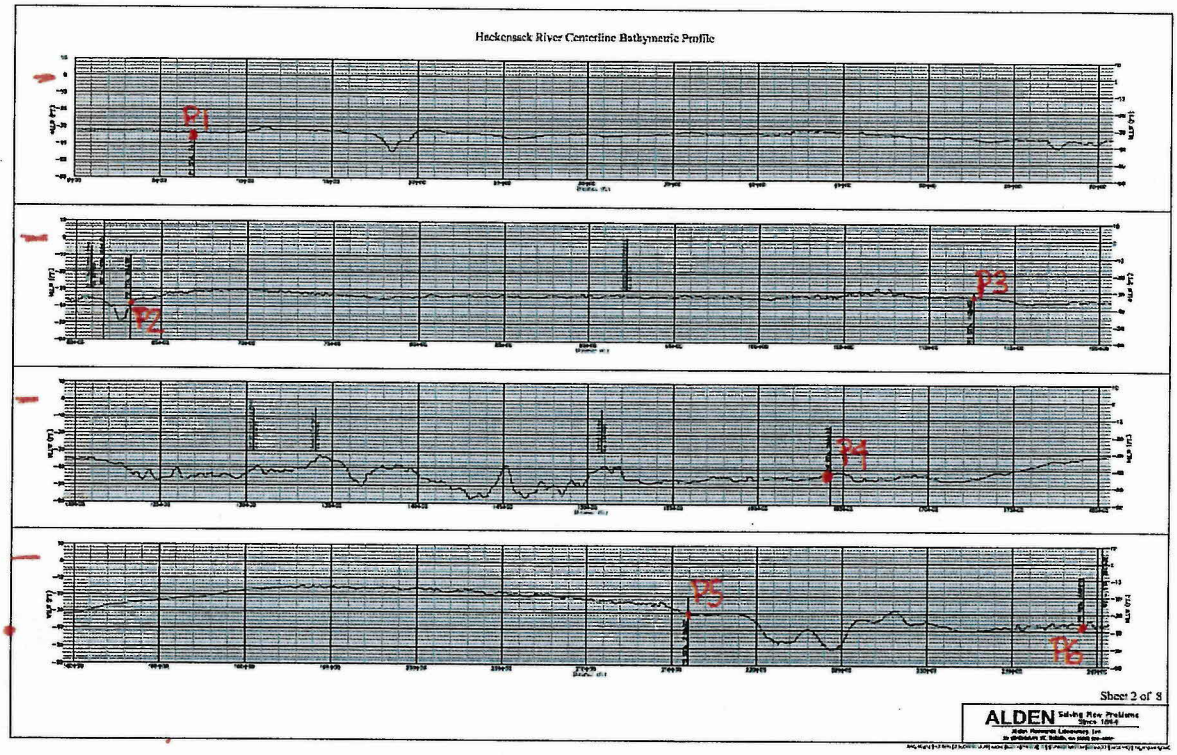
Please explain how the cross-section profile was extrapolated above the MLLW elevation, since by definition, for the vast majority of time the river surface elevation, and hence the volume available for wastewater assimilation and surface area available for reaeration exceeds that of MLLW. Of special note is the observation (pg. 38) "Tidal elevations do tend to be over predicted (by as much as a 'half foot') during spring tides"

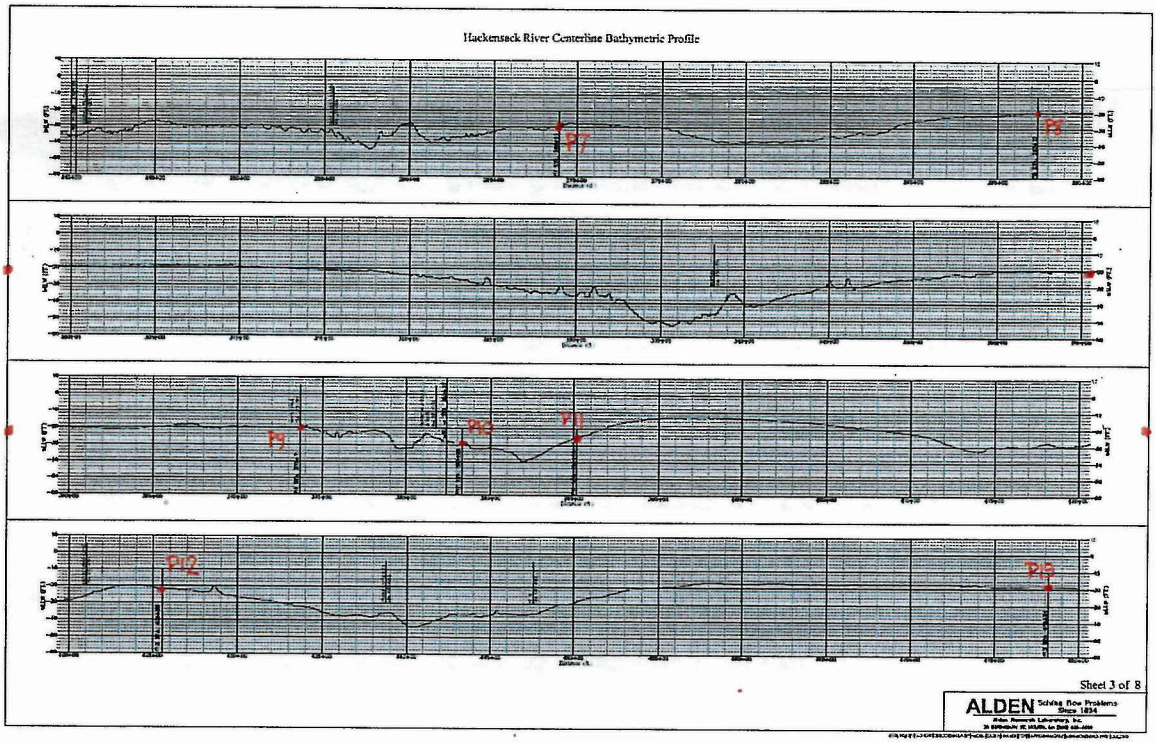
See example cross-sections Profiles 5 & 6 below, where the lateral extent definition terminates at approximately MLLW.

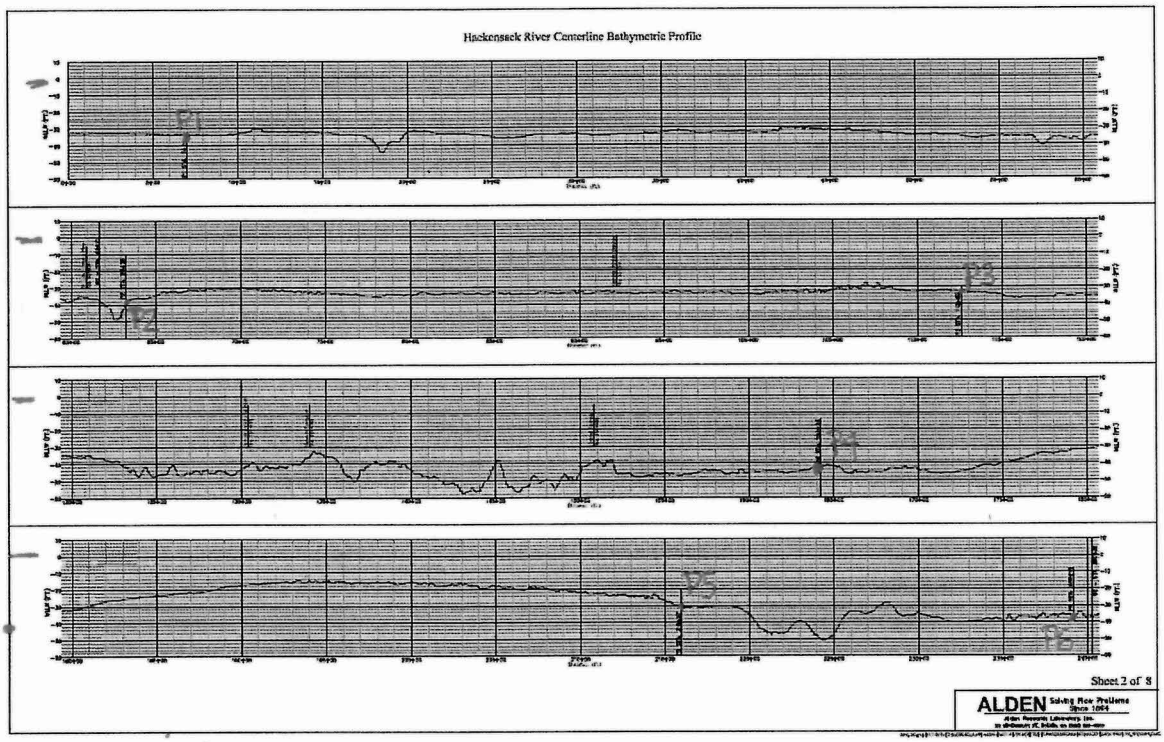


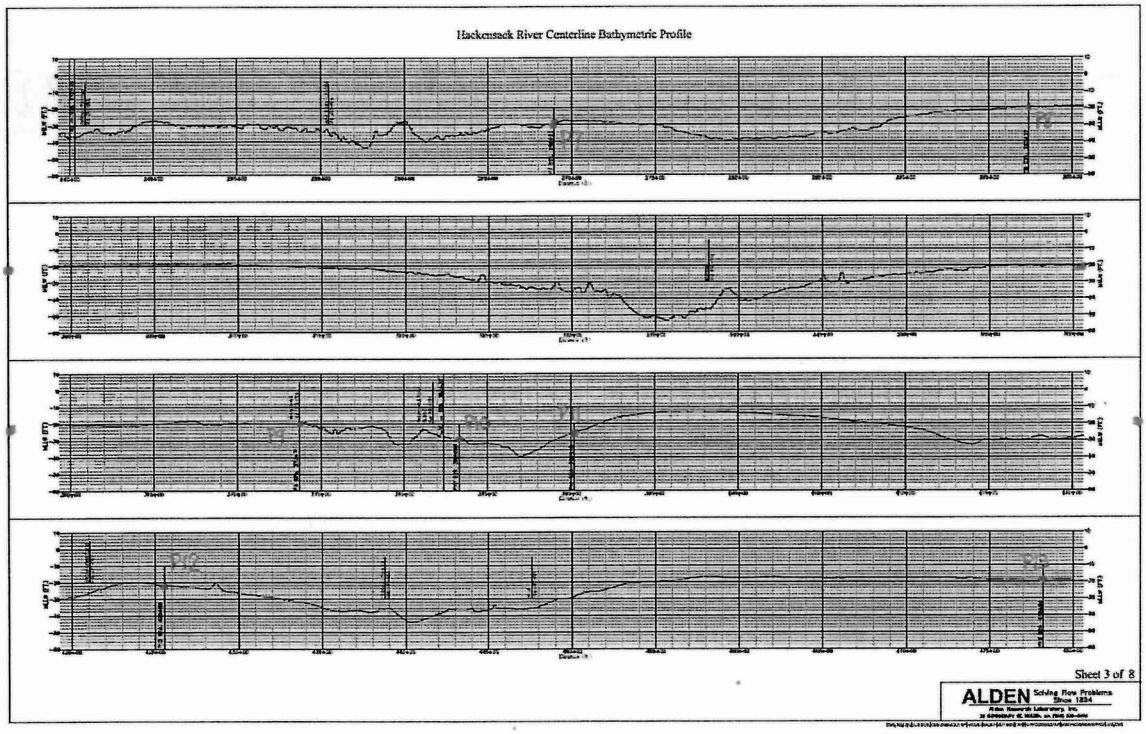
Bathymetric Profiles (depths)

As shown below the Alden cross-sectional area (CSA) profiles (i.e. App D - The figures should note the date of the survey.) were taken at non-uniform longitudinal spacing intervals. Review of the model geometry should allow how the possibly significant depth variation were handled (e.g. between P8 and P9). It would be informative to have the selected model average depth assigned shown on the App D. figures and report Figure 2.2 in addition to a CSA plot.


Hackensack River Centerline Bathymetric Profile
P1
P2
P3
P4
P5
P6
Sheet 2 of 8
ALDEN


Hackensack River Centerline Bathymetric Profile
P7
P8
P9
P10
P11
P12
P13
Sheet 3 of 8
ALDEN

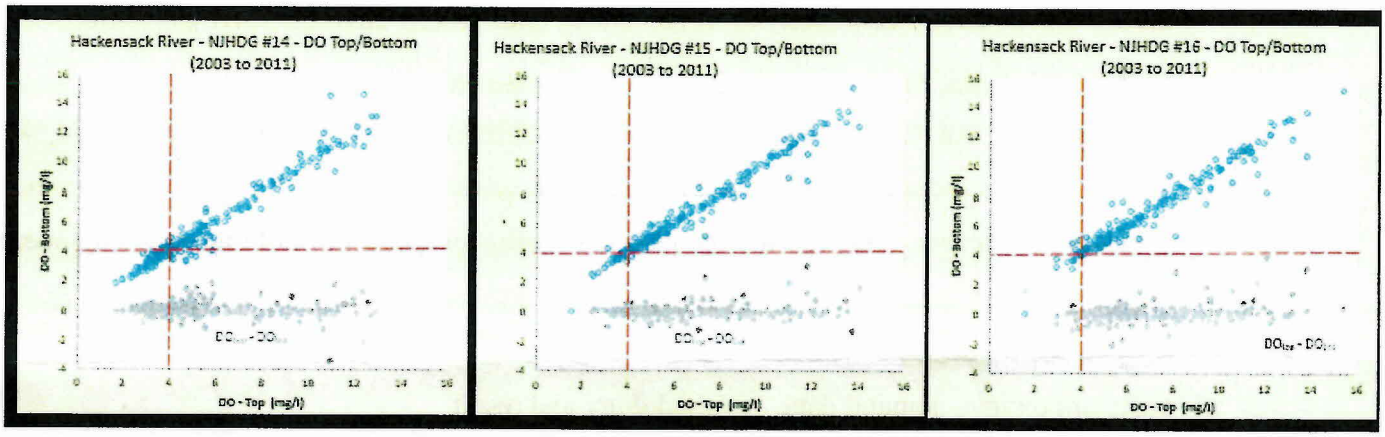


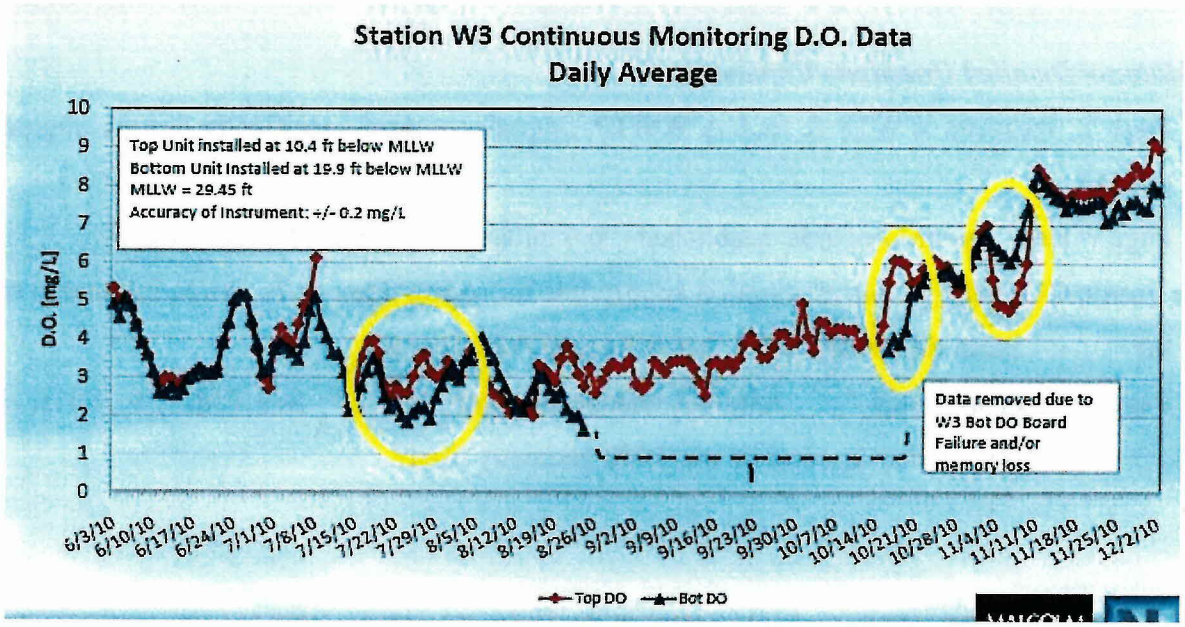


Vertically Well Mixed

Review of historical NJHDG data, that was readily available prior to the start of the study (STORET: 2003 – 2011), indicates that in terms of the dissolved oxygen resource the vertically

well-mixed assumption, made on the basis of salinity data should be reviewed. This is of particular note, given that the water quality objective is the dissolved oxygen resource and even though from a hydrodynamic perspective adequate longitudinal behavior can be replicated it is imperative from a regulatory perspective that given the anywhere/anytime requirements, of the DO standard – is required to maintained a viable fishery. Therefore, the ability to predict the vertical structure of the dissolved oxygen resource is important, and when it is not being calculated an appropriate adjustment factor must be incorporated when TMDL allocations are computed.





Also, the 9 May 2011 presentation entitled, "Status of the Implementation of the BCUA LHR Nutrient Phase II TMDL Study Sampling & Monitoring Workplan".

Overall Model Calibration

Review of the model comparison plots revealed numerous model calibration components that warrant additional review. We especially would like to understand how point source and tributary carbon is handled by the model and its impact on the dissolved oxygen resource. For example, in conventional water quality modeling the ratio of the Ultimate CBOD to the 5-day BOD is an important parameter that is measured in the field program and specifically detailed in the report. We especially need to be able to review and understand:

a) the impact of the tidal areas, and especially why a complete compliment of water quality data seems not to have been taken at W10. These data would have allowed estimation of the importance of the wetlands on the dissolved oxygen resource;

b) the impact of the 1-D assumption regarding dissolved oxygen and not directly computing diurnal DO in conjunction with the phytoplankton calculation – which could be important for projection purposes. One must note that the entire purpose of building this engineering computational framework is to be able to directly address the "anytime / anywhere" dissolved oxygen standard; and

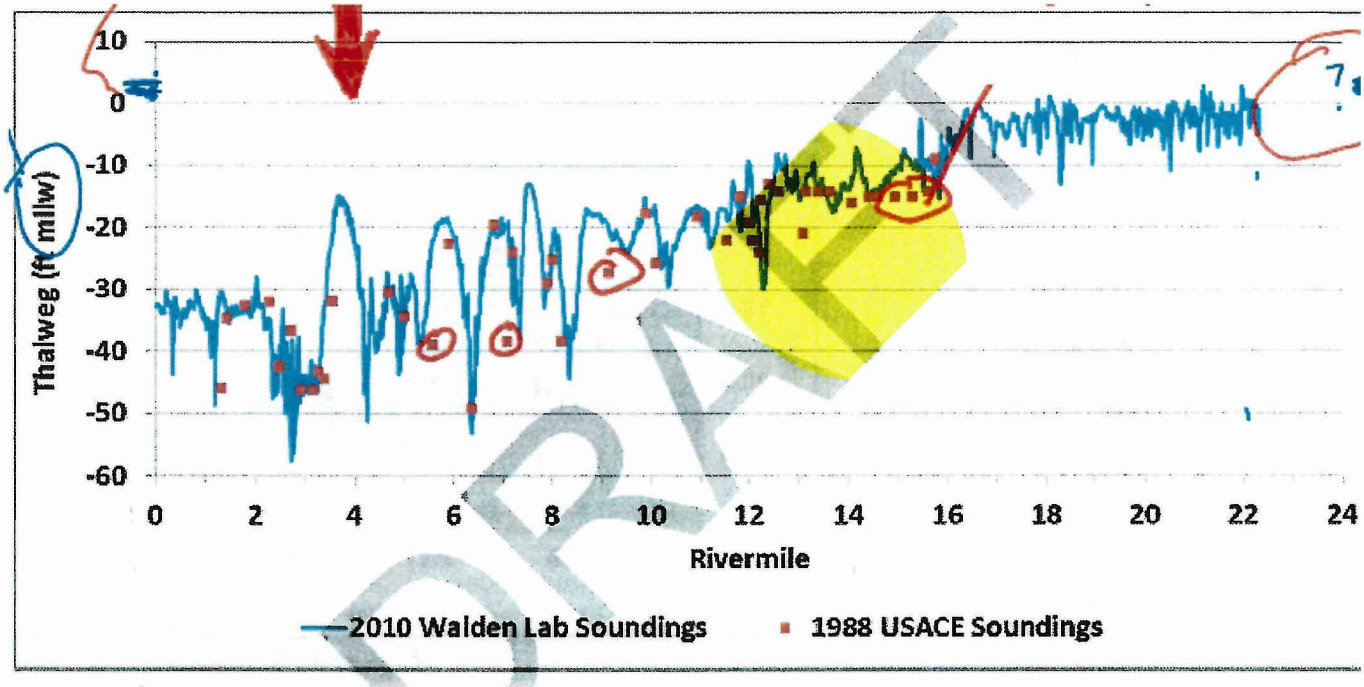
c) sediment oxygen demand data – methodology and result

Additional Detailed Questions/Comments

a) Page 6. Secaucus WWTP & BCUA WWTP Upgrades – what specifically did the upgrades entail?

b) Page 7. How was head-of-tide established ("0.6 miles downstream of Oradell dam",
See Profile CL6.pdf)? Is this assumption appropriate for spring tides ~8 ft., while it is stated that the mean tidal range is 5.2 feet at Kearny Point (pg. 8).

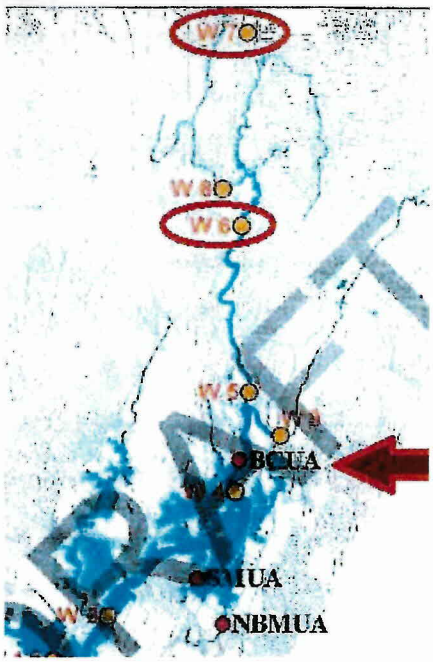
c) Page 7. Report states ". . . minimal change in depth over..." See RM 7, 9, 14/16 etc. Was geometry updated or was 1988 geometry used?



d) Page 8. It is not clear how "tidal Prism" is being handled by the model.

e) Page 9. Vertical 'well mixed / weakly stratified'. See discussion above.

f) Page 9. Lateral Variability. Was check for lateral variability only conducted at stations W6 and W7, which are narrow upstream stations? Were samples at the other stations laterally composited? One would think that all stations (and especially those upstream & downstream of BCUA) should be checked and that not only lateral but vertical measurements should be made. When the W6 & W7 checked was the design and execution – to take these measurements at 'slack' or 'flood' or 'ebb'?



g) Page 10. 'lack of clear diurnal signal . . . suggests that algal productivity is not a major process …"

How to reconcile this statement with high Chlorophyll a concentrations (> 100 ug/l), MERI supersaturated DO concentrations and the observations at W6 (pg. 168)

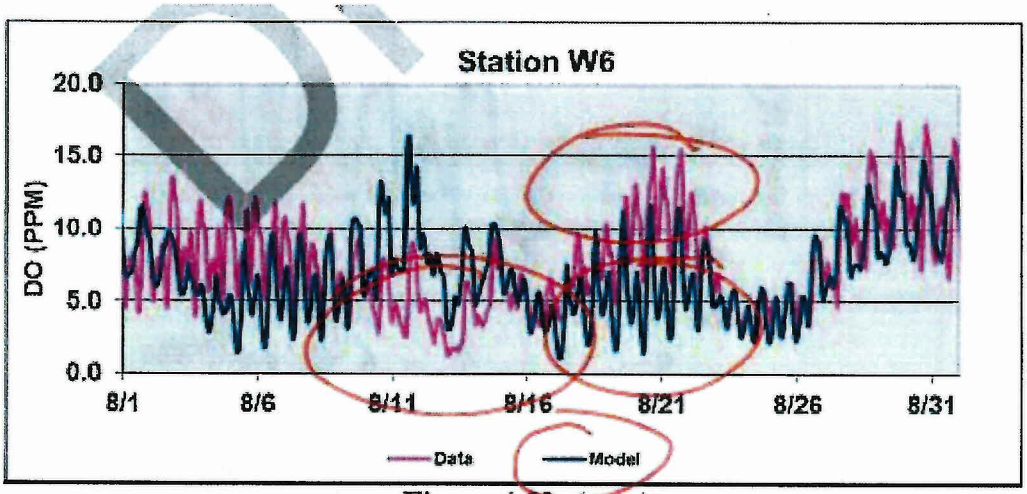


Figure 4.58: (cont)

We suggest that you may also want to focus on available inorganic N & P versus TN & TP when discussing nutrient limitations.

h) Page 14. Why was W10 not included in the water quality sampling – especially since important component in system in regards to the DO and nutrients? Was this based on system knowledge obtained during the 1980's studies, and if so – what is the reference?

i) Page 15. Table 3.3 - Chlorophyll -a. Is it total or 'corrected'? If 'corrected' could you supply phaeophytin concentrations? Assume CBOD is 5 day. Were any ultimate BOD measurements taken for WWTPs? Again – why no W10?

j) Page 20. 'Precision' of 25% qualifies as 'reproducible' and 50% for Chlorophyll a". Please provide the minimum and maximum results from the duplicates in Table 3.7, in addition to the mean and median. Also, please provide the raw QA/QC data. Does the footnote regarding "non-detects" mean that when there was a detect and a non-detect pair that was excluded – or just when both samples in the pair were non-detects, only then were they excluded?

k) Page 21. Review "Intense algal activity' versus page 10 comment: ". 'lack of clear diurnal signal . . . suggests that algal productivity is not a major process …" Table 3.8. Why are W10 or tribs DO data not included?

l) Page 22. Table 3.9. W10 Temp data?

m) Page 65. Figure 2.2 – Would be instructive to overlay assigned model geometry – average depth.

n) Page 23. Would be helpful to provide flows (MGD).

o) Page 27. How was SOD handled? Static variable?

p) Page 27/28. "For the purposes of this study, certain modifications were made to enhance the model's algorithms including " a series six (6) points.

A thorough review of these assumptions will be made upon receipt of the code, etc., therefore consider these comments preliminary:

Bullet 1. 'Temperature dependency was included to better account for seasonal intrusion of more resistant species (diatoms)". Was the basis of this statement – actual cell counts, cell volumes etc.?

Bullet 4. 'Modification of the model's temperature optimal curve …". Was there a literature citation that was used for a basis of this modification?

Bullet 5. 'Modification of the model's optimal solar radiation . . .". Was there a literature citation that was used for a basis of this modification?

Bullet 6. " . . . zooplankton were 'zeroed out' Was the basis of this statement – actual cell counts, cell volumes etc.?

q) Page 29. If dynamically computing phytoplankton – why not dynamically compute DO?

r) Page 29 – 31. What is actual model geometry used?

s) Page 29. How was wet/dry handled in wetlands in terms of water quality delivered to the adjacent model segments?

t) Page 33. Why not use Suez data for Oradell Reservoir vs. W7?

u) Page 34. Organic N 'build-up rate' < --- technical basis. Is there no leaf pickup or is there a large portion of forest / parkland in the sewershed?

v) Page 34/35. What does this mean -> 'allow a constant sewage flow . . ." No diel Q variability?

w) Page 35. What improvements were made to BCUA between 1988 and 2010? Were ultimate CBODs measured in 1988?

x) Page 37. Were sensitivities performed for Manning's 'n' (e.g. 0.015 and 0.030 and what were impact on tidal height, etc., especially in regards to the spring tide "… half foot" difference?

y) Page 38. – Get data or provide 'deltas for model / real-time data comparisons

z) Page 43. - '. . . not surprising . . .' lateral variation. I recommend the entire 'lateral' sampling assumption be reviewed at all stations – in case they are actually compositing.

aa) Page 45. Reaeration formulation – does not appear to have a lower bound for slack tide, when velocities can approach zero – but when there is still reaeration occurring – K_L on the order of 2 to 4 ft/day, where Ka = K_L / DEPTH

bb) Page 45. "Algal data suggests . . ." What is reference / where is the data?

cc) Page 46. Some coefficient decisions will be reviewed (e.g. SOD temperature correction coefficient, optimal temperature for growth, SOD measurements, etc.) once all requested files and background information is furnished and reviewed.

dd) Page 47. Please provide a graphical comparison of computed light extinction vs. Secchi Depth. SOD difference between surveys should be reviewed. October SODs seem to be significantly lower than what would have been expected for this type of system. A full review of the SOD will be undertaken, after delivery of requested materials.